

Remarks/Arguments:

Claims 1, 2, and 5-12 are presently pending. Claims 3 and 4 have been cancelled. Claims 1 and 10 have been amended. Reconsideration is respectfully requested in view of the above amendments and the following remarks.

Claim Rejections Under 35 U.S.C. § 103

Claims 1-12 stand rejected under 35 U.S.C. 103(a) as unpatentable over Nobuo et al. (JP S62-44108) in view of Goodnight (US Pat. 6457561B1) further in view of Choi (US Pat. 5971724) and Stocklein et al. (US 2,996,240). However, Applicant respectfully submits that these claims are patentable over the cited references for the reasons set forth below.

Cross-sectional area / Lead features

Applicant's invention, as recited by claim 1, includes features which are not disclosed, taught, or suggested by the cited art, namely:

...the shaft includes...

...a forward leading groove engraved on an outer wall of the main shaft...

...a reverse leading groove having a lead directing in an opposite direction to that of the forward leading groove...

...wherein the reverse leading groove has at least one of (1) a cross-sectional area smaller than that of the forward leading groove and (2) a lead greater than that of the forward leading groove....

The shaft includes a forward leading groove and a reverse leading groove having a lead in an opposite direction from the forward leading groove. The reverse leading groove has a cross-sectional area smaller than that of the forward leading groove and/or a lead greater than that of the forward leading groove. This feature is described in the application, for example, at page 4, lines 16-22; and FIGS. 1-3. No new matter is added.

Applicant respectfully submits that the cited art fails to disclose, teach, or suggest at least the above features of claim 1.

Nobuo is directed to a rotary shaft for a compressor. As shown in FIG. 2, for example, Nobuo discloses a shaft 11 having a spiral groove 11c. See Nobuo at FIG. 2. Nobuo fails to disclose, teach, or suggest another spiral groove having a lead in an opposite direction from spiral groove 11c.

Choi is directed to a hermetic compressor. As shown in FIGS. 1 and 2, Choi discloses a rotating shaft 4 including an oil groove 12. See Choi at FIGS. 1 and 2. Choi fails to disclose, teach, or suggest another oil groove having a lead in an opposite direction from oil groove 12.

Stocklein is directed to a compressor. As shown in FIGS. 2-3A, Stocklein discloses a shaft 7 having an axial bore 18. Shaft 7 is positioned in bearing 6. Bearing 6 includes vertical groove a which is in communication with storage chamber b. See Stocklein at column 3, line 38 to column 4, line 2, and FIGS. 2-3A. Stocklein fails to disclose, teach, or suggest a forward leading groove or a reverse leading groove formed in shaft 7.

Goodnight is directed to a pumping system. As shown in FIGS. 6-11, Goodnight discloses a shaft 32 including a pair of helical grooves 42 and 44. Goodnight discloses that helical grooves 42 and 44 "may or may not be a reflection, or mirror-image" of each other. See Goodnight at column 7, lines 10-11, and FIGS. 6-11.

The Office Action asserts that Goodnight discloses "[c]rossectional area of the reverse leading groove is smaller than that of the forward leading groove." The Office Action further asserts that Goodnight discloses "Lead of the reverse leading groove is greater than that of the forward leading groove." Applicant respectfully disagrees.

Goodnight merely discloses that helical grooves 42 and 44 may not be mirror-images of each other. Goodnight does not disclose, teach, or suggest the importance of the forward leading groove (groove 42 in FIG. 14) having a greater cross-sectional area or smaller lead than the reverse leading groove (groove 44 in FIG. 14). As explained in Applicant's specification, "because reverse leading groove 139 has a cross-sectional area smaller than that of forward leading groove 137, and reverse leading groove 139 has a lead greater than that of forward leading groove 137, the down-force generated by reverse leading groove 139 is so small that lubrication similar to the prior art can be maintained when the motor rotates in the forward direction." See the application at page 6, lines 6-11. Goodnight does not recognize this advantage, and is entirely devoid of any teaching of this feature.

Accordingly, for the above reasons, Applicant respectfully submits that the cited art fails to disclose, teach, or suggest "the reverse leading groove has at least one of (1) a cross-sectional area smaller than that of the forward leading groove and (2) a lead greater than that of the forward leading groove," as recited in claim 1.

Accordingly, for the reasons set forth above, claim 1 is allowable over the cited references. Withdrawal of the rejection and allowance of claim 1 is respectfully requested.

Claim 11, while not identical to claim 1, includes features similar to the allowable features discussed above with respect to claim 1. Thus, claim 11 is allowable over the cited art for at least the reasons set forth above with respect to claim 1. Withdrawal of the rejection and allowance of claim 11 is respectfully requested.

Claims 2, 5-10, and 12 include all of the features of claims 1 or 11, from which they depend. Thus, claims 2, 5-10, and 12 are also allowable over the cited art for at least the reasons set forth above with respect to claims 1 and 11. Withdrawal of the rejection and allowance of claims 2, 5-10, and 12 is respectfully requested.

Circumferential notch / Groove in shaft features

Applicant's invention, as recited by claim 1, includes features which are not disclosed, taught, or suggested by the cited art, namely:

...the shaft includes...

...a circumferential notch...having a lower axial surface...

...a forward leading groove engraved on an outer wall of the main shaft, the forward leading groove extending to and opening at the lower axial surface of the circumferential notch....

The shaft includes a circumferential notch and a forward leading groove. The forward leading groove extends to and opens at the lower axial surface of the circumferential notch. This feature is described in the application, for example, at page 4, line 16 to page 6, line 2; and FIGS. 1-3.

Applicant respectfully submits that the cited art fails to disclose, teach, or suggest at least the above features of claim 1.

Nobuo is directed to a rotary shaft for a compressor. As shown in FIG. 2, for example, Nobuo discloses a shaft 11 having a spiral groove 11c. See Nobuo at FIG. 2. Nobuo fails to disclose, teach, or suggest a circumferential notch formed in shaft 11. Thus, Nobuo fails to disclose spiral groove 11c extending to and opening at a lower axial surface of a circumferential notch.

Choi is directed to a hermetic compressor. As shown in FIGS. 1 and 2, Choi discloses a rotating shaft 4 including an oil groove 12. See Choi at FIGS. 1 and 2. Choi fails to disclose, teach, or suggest a circumferential notch formed in rotating shaft 4. Thus, Choi fails to disclose oil groove 12 extending to and opening at a lower axial surface of a circumferential notch.

Goodnight is directed to a pumping system. As shown in FIGS. 6-11, Goodnight discloses a shaft 32 including a pair of helical grooves 42 and 44. See Goodnight at column 7, lines 10-11, and FIGS. 6-11. Goodnight fails to disclose, teach, or suggest a circumferential notch formed in shaft 32. Thus, Goodnight fails to disclose helical grooves 42 or 44 extending to and opening at a lower axial surface of a circumferential notch.

Stocklein is directed to a compressor. As shown in FIGS. 2-3A, Stocklein discloses a shaft 7 having an axial bore 18. Shaft 7 is positioned in bearing 6. Bearing 6 includes vertical groove a which is in communication with storage chamber b. See Stocklein at column 3, line 38 to column 4, line 2, and FIGS. 2-3A. Stocklein fails to disclose grooves formed in shaft 7. Thus, Stocklein fails to disclose grooves extending to and opening at a lower axial surface of storage chamber b.

Thus, none of the references cited by Examiner discloses a forward leading groove formed in a shaft that extends to and opens at the lower axial surface of a circumferential notch. Nonetheless, the Office Action argues that the combination of Nobuo and Stocklein discloses this feature. Applicant respectfully disagrees.

First, one of ordinary skill would not combine Nobuo and Stocklein as suggested by the Examiner. The lubricant pathway of Stocklein comprises both vertical groove a and storage chamber b. Applicant submits that if one of ordinary skill modified the lubricant pathway of Nobuo based on the teachings of Stocklein, he or she would include both vertical groove a and storage chamber b. Thus, Nobuo, as modified by Stocklein, would include a groove formed in

the bearing wall (vertical groove a), and no groove formed on the shaft. As explained above, this combination of features does not meet the limitations of claim 1.

Second, even if one of ordinary skill were to combine Nobuo and Stocklein as suggested by the Examiner, the combination would not achieve the advantages of the claimed invention. As explained in the present application, the above-recited features of claim 1 are important because "[F]orward leading groove 137 opens into inner rim of annular lubricant groove 141, and the lubricant is pushed to the outer rim of annular lubricant groove 141 by the centrifugal force [generated by the rotation of main shaft 123], so that little amount of the lubricant flows [backward] into forward leading groove 137." See the application at page 7, lines 11-14.

To the contrary, Nobuo does not disclose a circumferential notch in shaft 11. Thus, no centrifugal force acts on the lubricant of Nobuo. Similarly, Stocklein does not disclose a groove formed in the shaft. Thus, no centrifugal force acts on the lubricant passing through the groove in the bearing of Stocklein. Applicant submits that the cited references, either alone or in combination, fail to address the problem solved by the features of claim 1.

Accordingly, for the above reasons, Applicant respectfully submits that the cited art fails to disclose, teach, or suggest "a forward leading groove engraved on an outer wall of the main shaft, the forward leading groove extending to and opening at the lower axial surface of the circumferential notch," as recited in claim 1.

Accordingly, for the reasons set forth above, claim 1 is allowable over the cited references. Withdrawal of the rejection and allowance of claim 1 is respectfully requested.

Claim 11, while not identical to claim 1, includes features similar to the allowable features discussed above with respect to claim 1. Thus, claim 11 is allowable over the cited art for at least the reasons set forth above with respect to claim 1. Withdrawal of the rejection and allowance of claim 11 is respectfully requested.

Claims 2, 5-10, and 12 include all of the features of claims 1 or 11, from which they depend. Thus, claims 2, 5-10, and 12 are also allowable over the cited art for at least the reasons set forth above with respect to claims 1 and 11. Withdrawal of the rejection and allowance of claims 2, 5-10, and 12 is respectfully requested.

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Conclusion:

Applicant respectfully asserts that the above-identified application is in condition for allowance, which action is respectfully requested.

Respectfully submitted,


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